

Infective Endocarditis

Anish Bhatt, MD

Associate Professor, Division of Cardiology

Associate Program Director, Cardiology Fellowship

Director, Advanced Echocardiography Fellowship

Our 45-Minute Mission

- Describe the burden and risk of infective endocarditis
- Characterize high yield clinical diagnostics and therapeutics
- Understand surgical indications for infective endocarditis

Question # 1

- What is the most common risk factor for infective endocarditis in adults in Africa?
 - Rheumatic Heart Disease
 - Bicuspid Aortic Valve
 - Intravenous Drug Use
 - Congenital heart defects

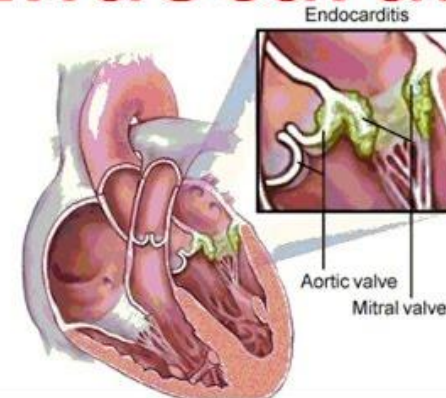
Question # 2

- Which of the following is an indication for surgery in patients with infective endocarditis?
 - ECG with Wenkebach (Mobitz type I AV block)
 - 0.8 cm calcified vegetation on the mitral valve
 - Vertebral artery stroke
 - Presence of Roth spots and Janeway lesions on exam

Infective Endocarditis

- Infection of the heart tissue, generally valve
- Can spread from one to another valve, form abscesses
- Can spread into the electrical conduction system
- Can lead to systemic or pulmonary emboli

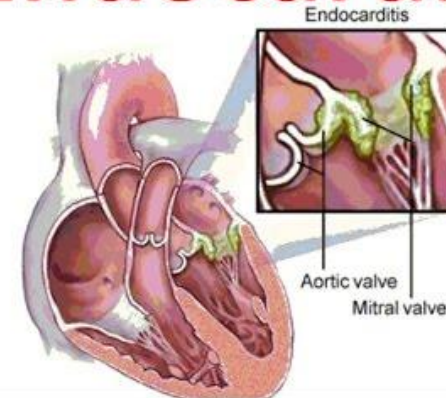
Endocarditis



Infective Endocarditis

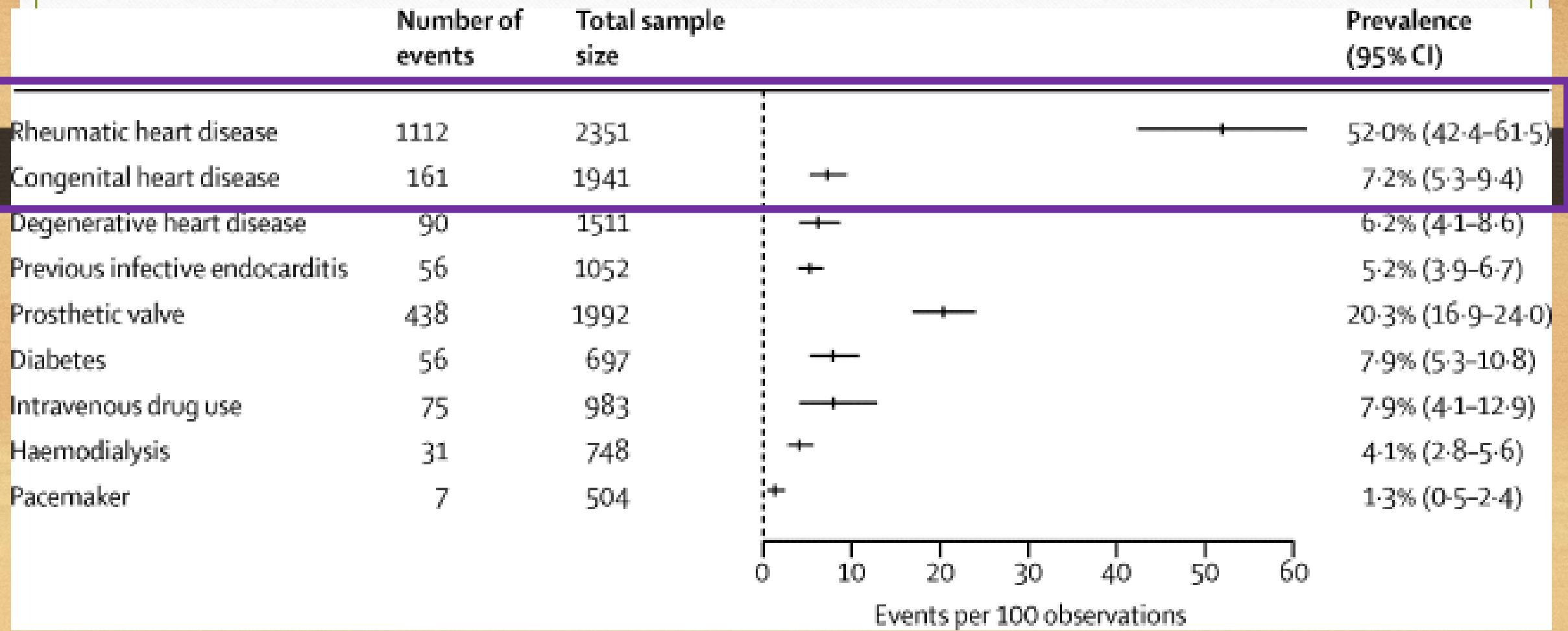
- Infection of native or prosthetic valve
- 10 cases in every 100,000 worldwide
- Associates with severe complications: stroke, pulmonary embolism, heart failure, heart block
- 20% in hospital mortality, 40% over 5 years

Endocarditis



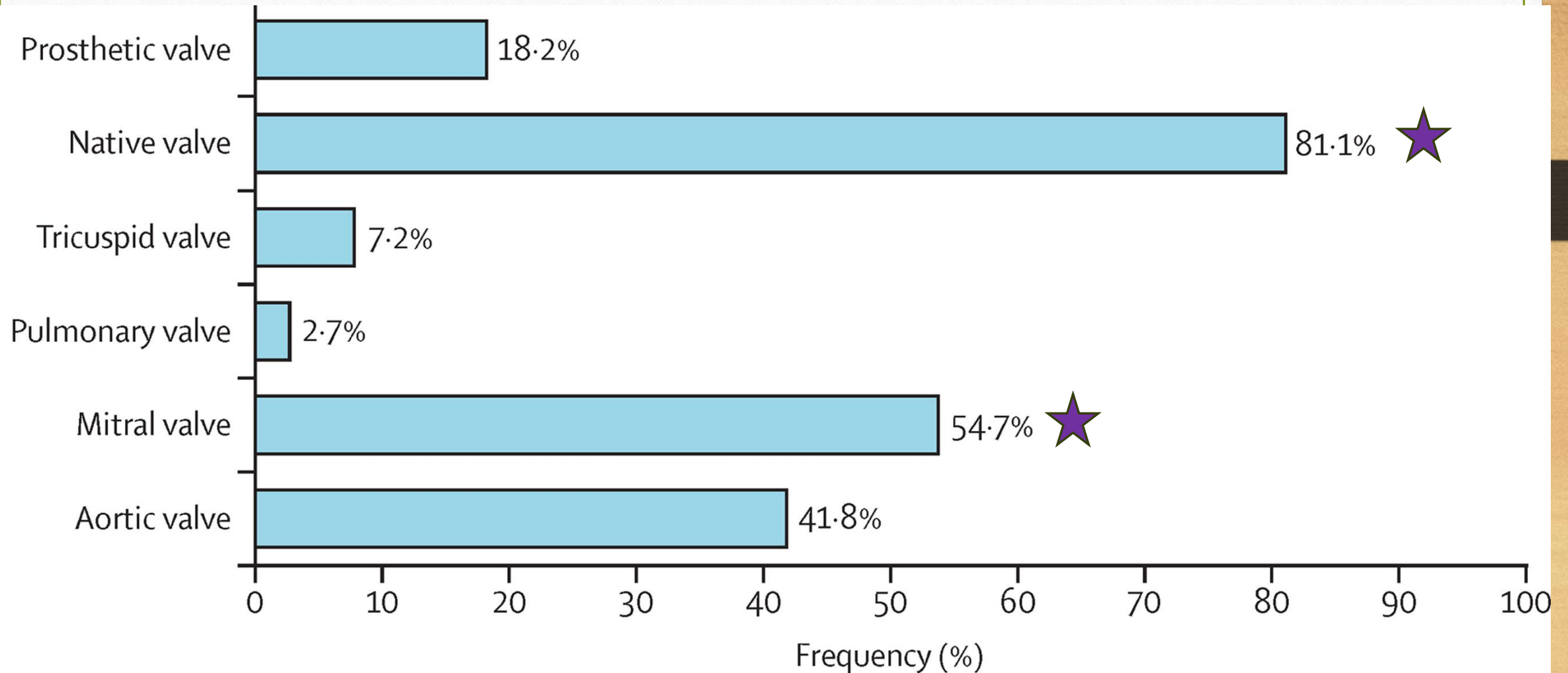
Infective Endocarditis in Africa

Over 2100 cases of infective endocarditis retrospectively analyzed between 1996-2020



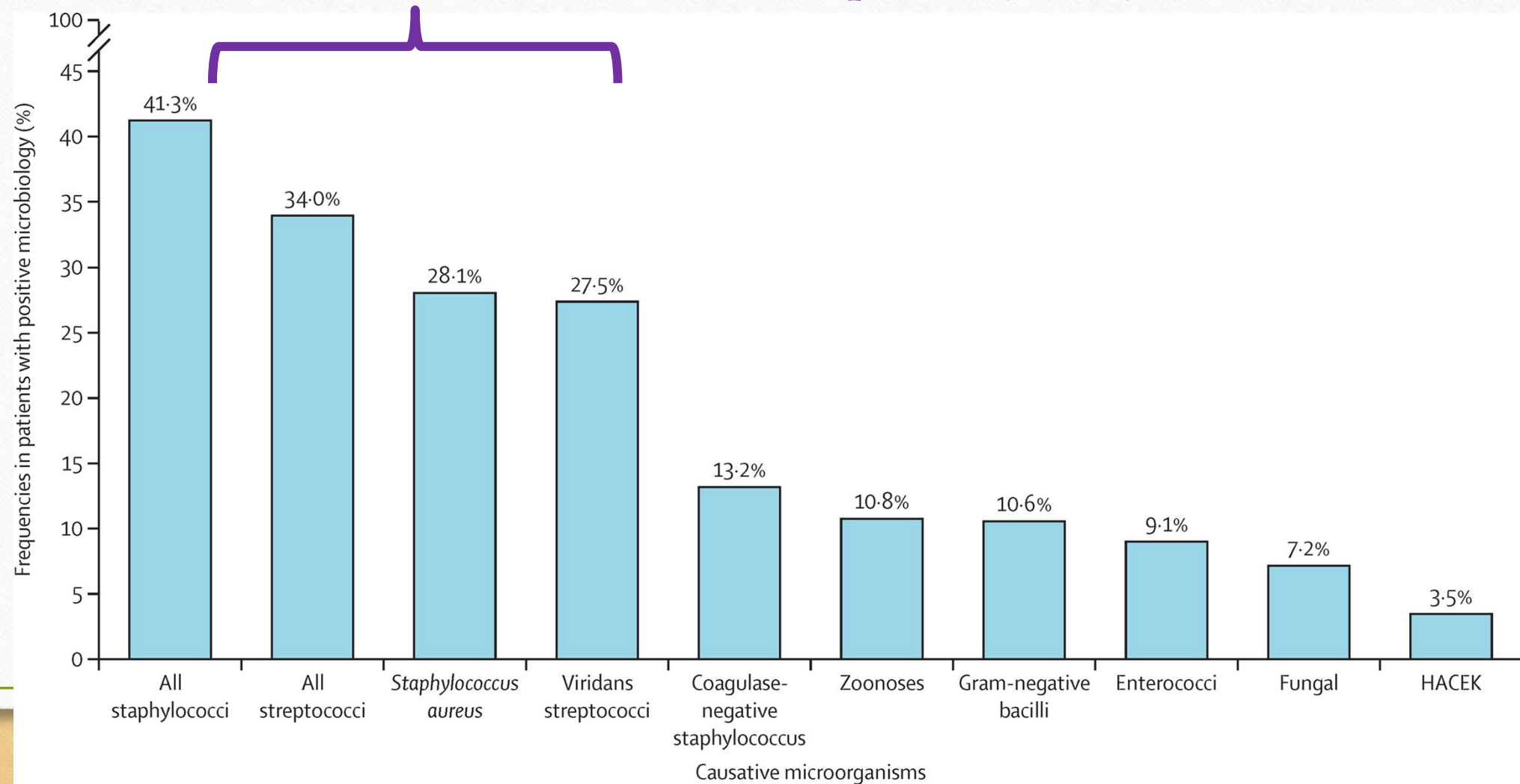
Native Mitral Valve Most Affected

Over 2100 cases of infective endocarditis retrospectively analyzed between 1996-2020



Staphylococcus and Streptococcus are Common

Over 2100 cases of infective endocarditis retrospectively analyzed between 1996-2020



Endocarditis Mortality is High in Africa

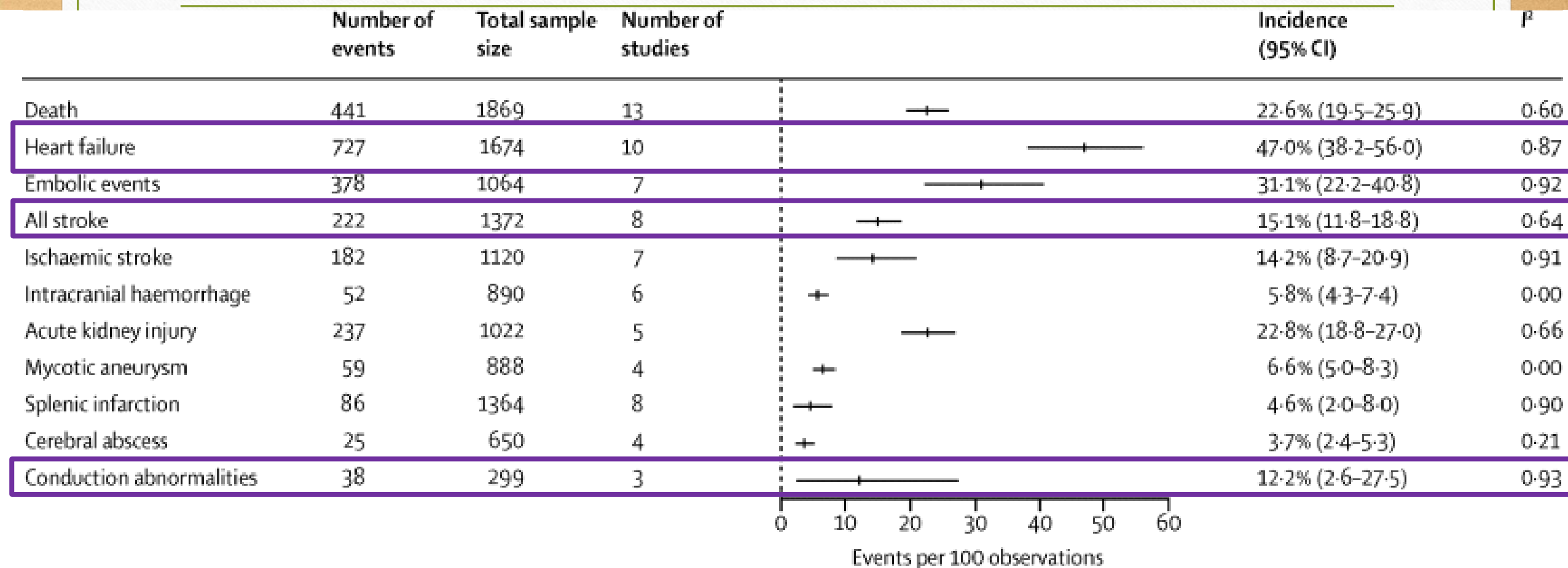
Over 2100 cases of infective endocarditis retrospectively analyzed between 1996-2020

	Cases	Sample		Weight	Incidence (95% CI)
Northern Africa		1610		76.8%	22.5% (18.8-26.4)
Sub-Saharan Africa		259		23.2%	22.7% (17.0-28.9)
Overall Study		1869		100.0%	22.6% (19.5-25.9)

22% mortality rate of all comers with endocarditis in Africa

Endocarditis Complications rates are High

47% of endocarditis patients developed Heart Failure; 15% with Stroke



Take Home Point # 1

In Africa, endocarditis is most seen in Rheumatic Heart Disease and carries a large burden of complications and death.

TABLE 1. Indications for Antimicrobial Prophylaxis¹

Prosthetic cardiac valves/material	• Transcatheter implanted prosthetic valves • Annuloplasty, rings, or clips • Left ventricular assist devices or implantable heart
Congenital heart disease (CHD)	• Unrepaired cyanotic congenital, including palliative shunts and conduits • Completely repaired defect with prosthetic material or device within 6 months after the procedure • Repaired CHD with residual defects at or adjacent to the site of prosthetic material • Surgical or transcatheter pulmonary artery valve or conduit placement
Previous, relapse, or recurrent infective endocarditis	
Cardiac transplant recipients who develop cardiac valvulopathy	
Rheumatic Heart Disease	

Take Home Point # 2

IE prophylaxis should be considered for patients with RHD in Africa, in addition to AHA/ESC recommendations for other populations

Common Causes of IE

- Bacterial > Non-bacterial (Marantic) > Fungal
 - Staph and Strep species dominate in prevalence and complication risk
- Culture negative endocarditis (challenging to culture, but presumed bacterial)
- Device-associated
- Prosthetic valve associated
- Rheumatic and Bicuspid valves have an association

IE is a Tough Diagnosis!

- Clinical symptoms are those of bacteremia/infection
- Lab work is often nonspecific
 - ESR/CRP (inflammatory markers)
 - WBC elevation
 - Bacterial organism isn't directive

Physical Examination

- Cardiac murmur can be helpful, but not specific/sensitive unless new
- Some key features on exam to look out for
 - Janeway lesions
 - Roth Spots
 - Osler Nodes
 - Splinter Hemorrhages

The Four Classic Peripheral Stigmata of Infective Endocarditis



Janeway lesions



Osler nodes



Roth spots



Splinter hemorrhages

The four classic peripheral stigmata of infective endocarditis are:

1. **Janeway lesions:** These are small, non-tender, painless bumps on the palms of the hands and soles of the feet. They are caused by emboli (small pieces of bacteria) that lodge in small blood vessels in the skin.
2. **Osler nodes:** These are tender, painful bumps on the fingertips and toes. They are also caused by emboli that lodge in small blood vessels in the skin.
3. **Roth spots:** These are small, round hemorrhages (bleeding) in the retina, the light-sensitive tissue at the back of the eye. They are caused by emboli that damage the blood vessels in the retina.
4. **Splinter hemorrhages:** These are small, linear hemorrhages under the fingernails or toenails. They are caused by emboli that damage the blood vessels in the nail beds.

1. Janeway lesions: Warfieldian (https://commons.wikimedia.org/wiki/File:Janeway_lesion.JPG), <https://creativecommons.org/licenses/by-sa/4.0/legalcode>

2. Osler nodes: Roberto J. Galindo (https://commons.wikimedia.org/wiki/File:Osler_Spots_foot.jpg), <https://creativecommons.org/licenses/by-sa/4.0/legalcode>

3. Roth Spots: Shutterstock ID 2377670685 by Kateryna Kon stock illustration

4. Splinter hemorrhages: Splarka (https://commons.wikimedia.org/wiki/File:Splinter_hemorrhage.jpg), „Splinter hemorrhage“, marked as public domain, more details on Wikimedia Commons: <https://commons.wikimedia.org/wiki/Template:PD-self>

2023 Modified Duke Criteria

- Complicated → but data driven and effective
- We will simplify a bit today, but please read and learn these criteria with every case/opportunity!



The 2023 Duke-ISCVID IE Criteria (Major)

Proposed Changes in Bold Type

Major	
Microbiologic	(1) Positive blood cultures i. Microorganisms that commonly cause IE isolated from two or more separate blood culture sets or ii. Microorganisms that occasionally or rarely cause IE isolated from three or more separate blood culture sets
	(2) Positive laboratory tests i. Positive PCR or other nucleic acid-based technique for <i>Coxiella burnetii</i>, <i>Bartonella species</i>, or <i>Tropheryma whippelii</i> from blood or ii. <i>Coxiella burnetii</i> antiphase I IgG antibody titer > 1:800, or isolated from a single blood culture or iii. Indirect immunofluorescence assays (IFA) for detection of IgM and IgG antibodies to <i>Bartonella henselae</i> or <i>Bartonella quintana</i> with IgG titer > 1:800
Imaging	(1) Echocardiography and Cardiac Computed Tomography Imaging I. Echocardiography and/or Cardiac CT showing vegetation, valvular/leaflet perforation, valvular/leaflet aneurysm, abscess, pseudoaneurysm, or intracardiac fistula or II. Significant new valvular regurgitation on echocardiography as compared to previous imaging. Worsening or changing of pre-existing regurgitation is not sufficient. or III. New partial dehiscence of prosthetic valve as compared to previous imaging
	(2) [18F]FDG PET/CT Imaging Abnormal metabolic activity involving a native or prosthetic valve, ascending aortic graft (with concomitant evidence of valve involvement), intracardiac device leads or other prosthetic material
Surgical	Evidence of IE documented by direct inspection during heart surgery neither Major Imaging Criteria nor subsequent histologic or microbiologic confirmation

The 2023 Duke-ISCVID Criteria for Infective endocarditis

Definite endocarditis	Pathologic Criteria	At least 1 of 2
	Clinical Criteria	2 Major
		1 Major and 3 Minor
		5 Minor



The 2023 Duke-ISCVID IE Criteria (Major)

Proposed Changes in Bold Type

The 2023 Duke-ISCVID Criteria for Infective endocarditis

Definite endocarditis	Pathologic Criteria	At least 1 of 2
	Clinical Criteria	2 Major
		1 Major and 3 Minor
		5 Minor

Major	
Microbiologic	POSTIVE BLOOD CULTURES identifying an organism that commonly associates with endocarditis
Imaging	Abnormal ECHOCARDIOGRAM or CARDIAC PET/CT
Surgical	Surgical removal → histology

If Using 2 MAJOR CRITERIA

**POSITIVE BLOOD CX +
IMAGING EVIDENCE**

The 2023 Duke-ISCVID Criteria for Infective endocarditis

Definite endocarditis	Pathologic Criteria	At least 1 of 2
	Clinical Criteria	2 Major
		1 Major and 3 Minor
		5 Minor

Minor clinical criteria

- Predisposition Added transcatheter valve implant/ repair, endovascular and prior IE.
- Fever Unchanged(>38 C).
- Vascular phenomena Added splenic and cerebral abscess.
- Immunologic phenomena Added definition for immune complex mediated Glomerulonephritis.
- Microbiological Added PCR or amplicon/metagenomic sequencing evidence of typical pathogen.
- Imaging Added PET/CT evidence < 3 months of cardiac surgery.
- Physical examination New auscultation of regurgitant murmur when Echocardiography is unavailable.

IF USING MINOR CRITERIA, REFER TO GUIDELINES!!

If Using 1 MAJOR + 3 MINOR CRITERIA

**POSITIVE BLOOD CX or
IMAGING EVIDENCE**

+

**Vascular phenomenon, Physical
exam, predisposition, etc.**

Why are minor criteria important?

- Bacterial Culture Negative Endocarditis rates may be higher than we appreciate
 - ~ 30% of patients in a small South African study had culture negative endocarditis
 - Bartonella being the most common cause of this (antibody testing confirmed)
- Transthoracic Echocardiography sensitivity for valvular vegetation can range between 40-80% based on many studies
 - Image quality
 - Echo done too early
 - Prosthetic valve limiting visualization

Take Home Point # 3

The 2023 Modified Duke Criteria are internationally accepted; > 80% sensitivity and specificity for IE diagnosis

Feared Complications of Endocarditis

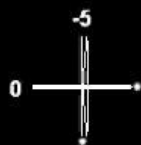
- Severe valve regurgitation (perforation) → acute heart failure
- Valve or aortic abscess
- Embolic phenomenon (Pulmonary, Visceral Organ, Stroke)
- Cardiac Conduction Disease (Heart Block)

Diagnostic Imaging Considerations

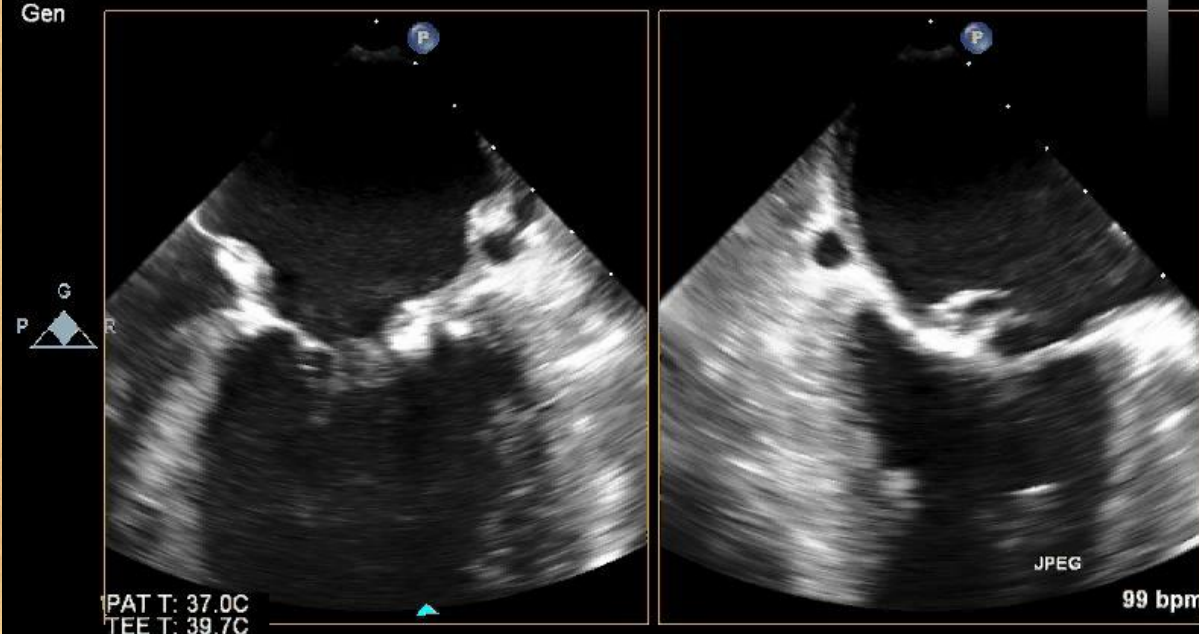
- Looking for vegetations
 - TTE – considered usual care; repeat in 3-5 days if clinical change
 - TEE – low threshold, and **always** for prosthetic valves
 - CARDIAC CT – prosthetic valves, abscess evaluation/confirmation. Gaining lots of momentum for non-bacterial/marantic endocarditis diagnosis
- Looking for emboli – clinically driven evaluation
 - BRAIN, LUNG, ABDOMEN

FR 29Hz
10cm

xPlane
68%
68%
50dB
P Off
Gen

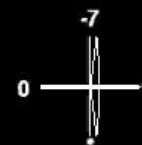


M4



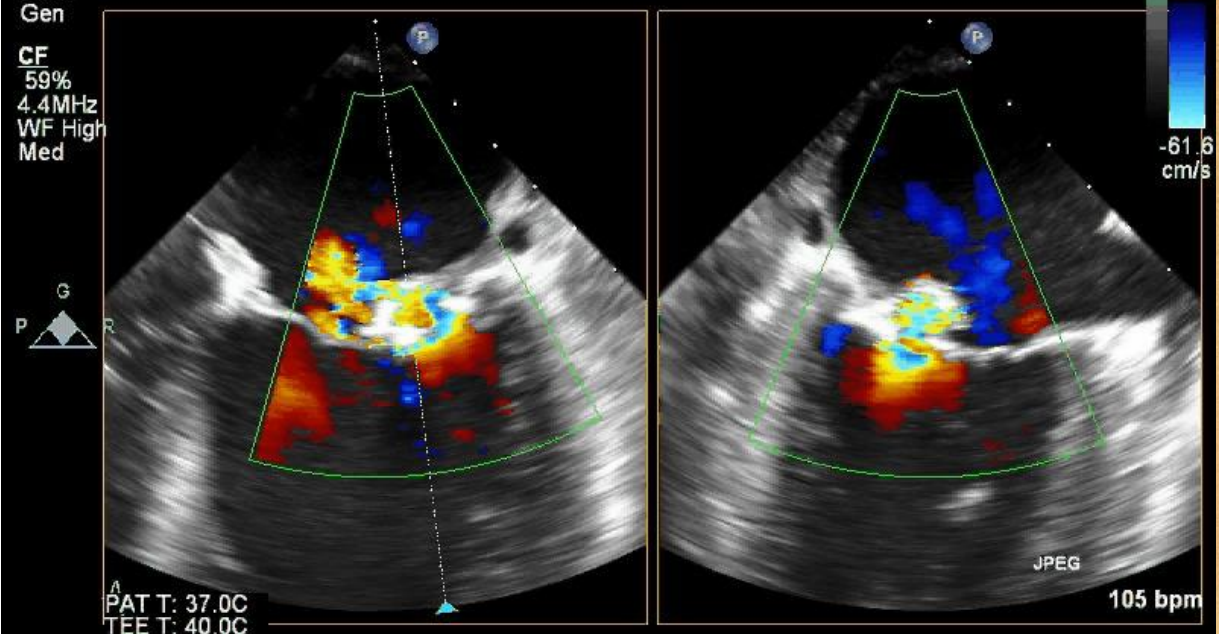
FR 9Hz
10cm

xPlane
70%
70%
50dB
P Off
Gen



M4 M4
+61.6

CF
59%
4.4MHz
WF High
Med



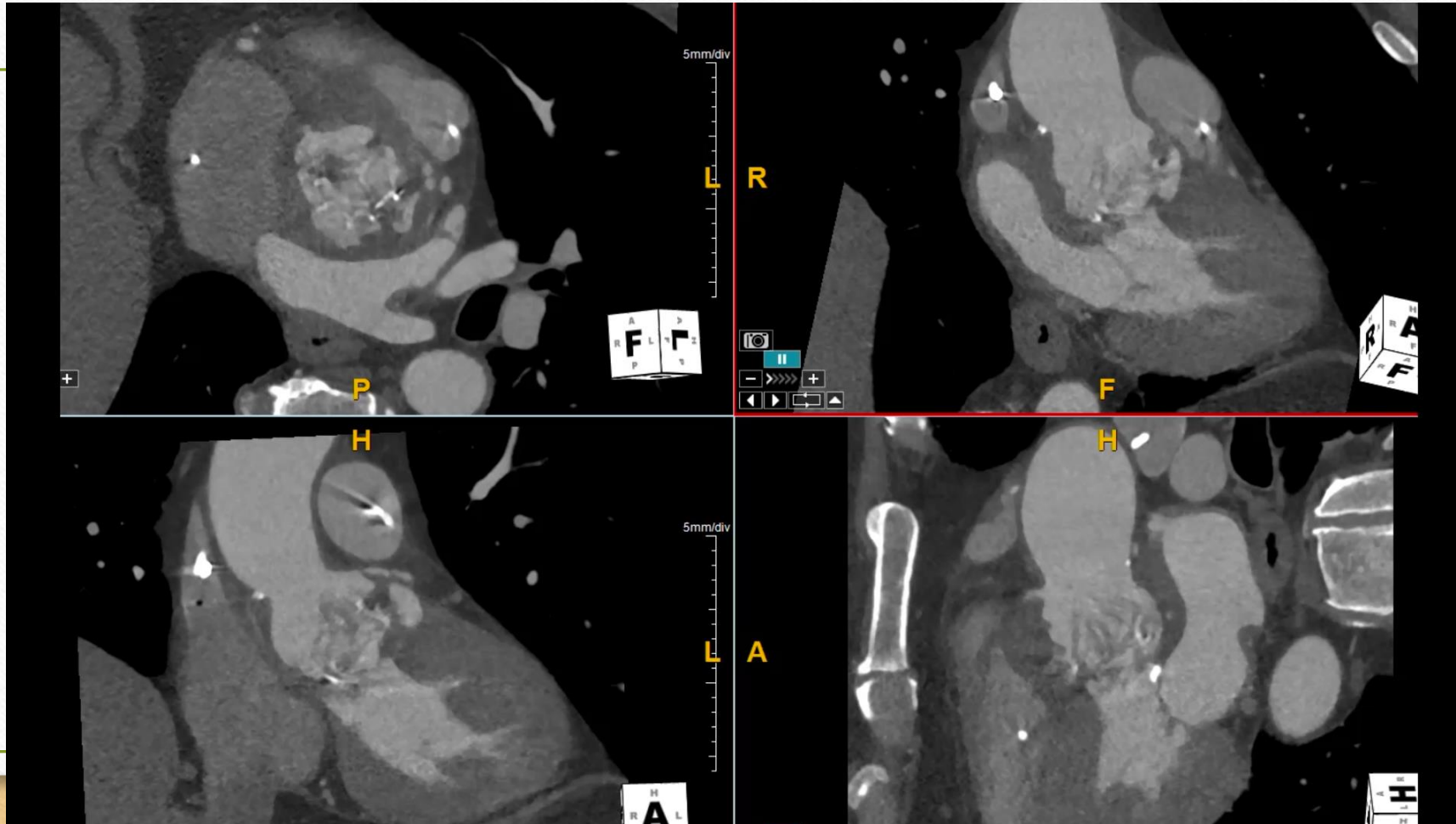
Cardiac CT is Powerful

Cardiac CT Findings of IE

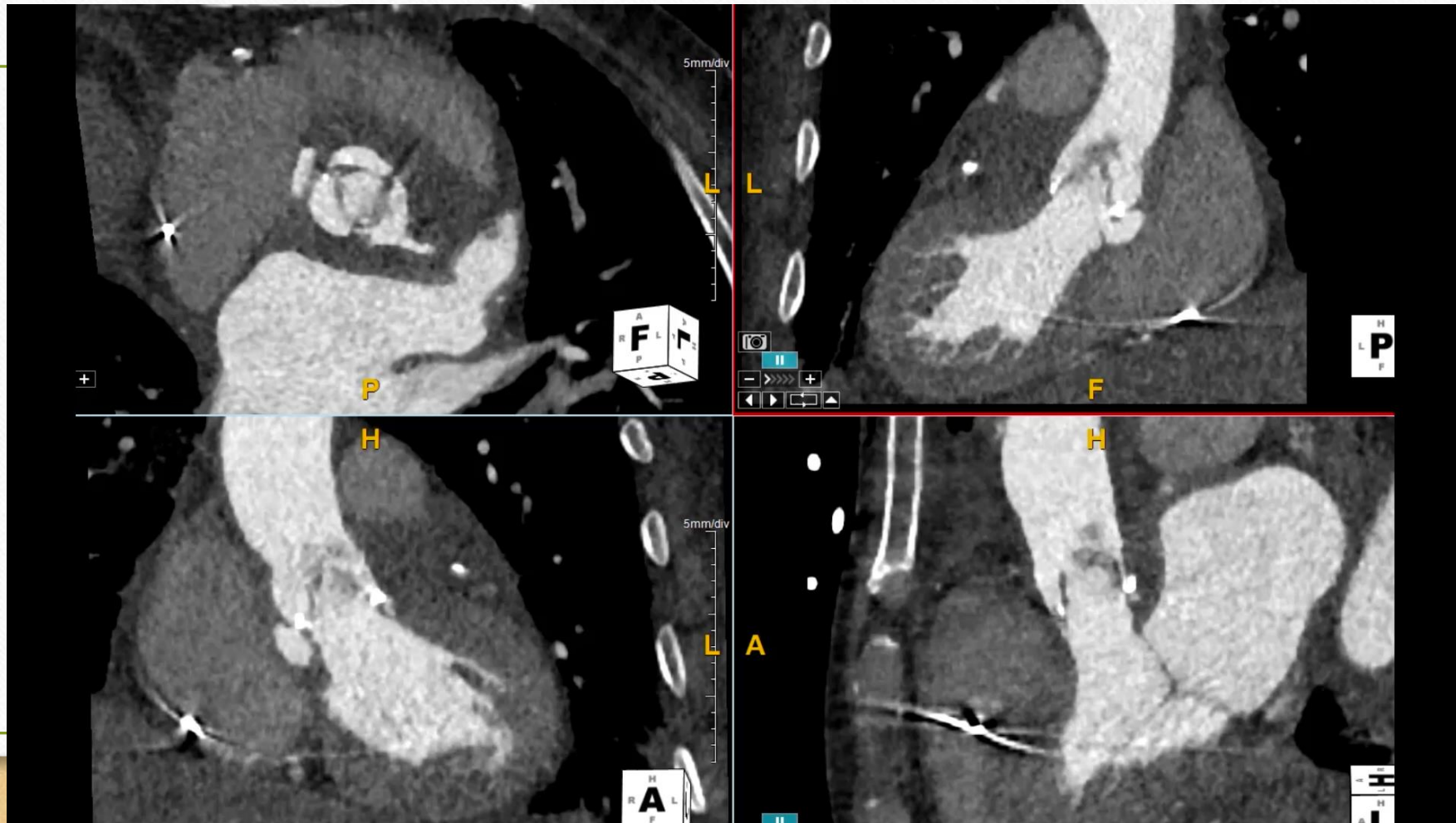
Imaging Finding	Cardiac CT
Vegetation	Low-to-intermediate attenuation lesions of variable sizes or focal thickening along valves, endocardium, or prosthesis
Perivalvular extension	
Perivalvular abscess	Low-attenuation area with a peripheral enhancing rim. Soft-tissue thickening surrounding cardiac or major vascular structures can be seen that may represent phlegmon or early abscess formation.
Pseudoaneurysm	- Perivalvular contrast material-filled cavity, often with - visualized direct connection with aortic root or cardiac chamber
Fistula	Contrast agent-filled tract interconnecting cardiac chamber with adjacent aortic root or coronary sinus
Prosthesis dehiscence	Malalignment of prosthesis with tissue defect between annulus and prosthesis. Rocking motions of the prosthetic valve of more than 15° on cine CT images can be seen.
Other leaflet abnormalities	
Leaflet perforation	Leaflet tissue defect observed in two different dimensional views
Aneurysm	Leaflet saccular outpouching

- Delay in TEE
- Inconclusive TEE for surgical indication
- Prosthetic Valve
- Patient worsening or in CHF and cannot tolerate TEE

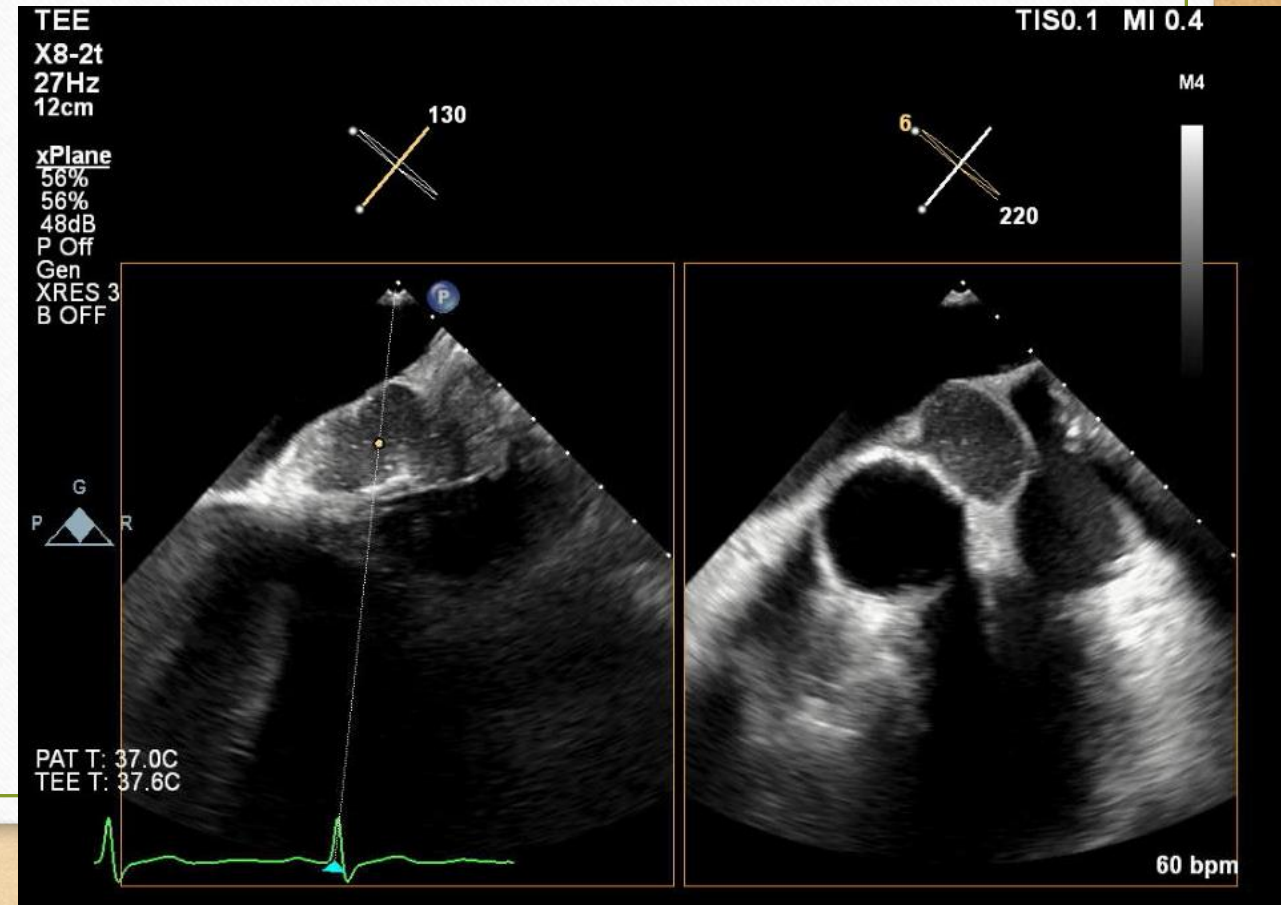
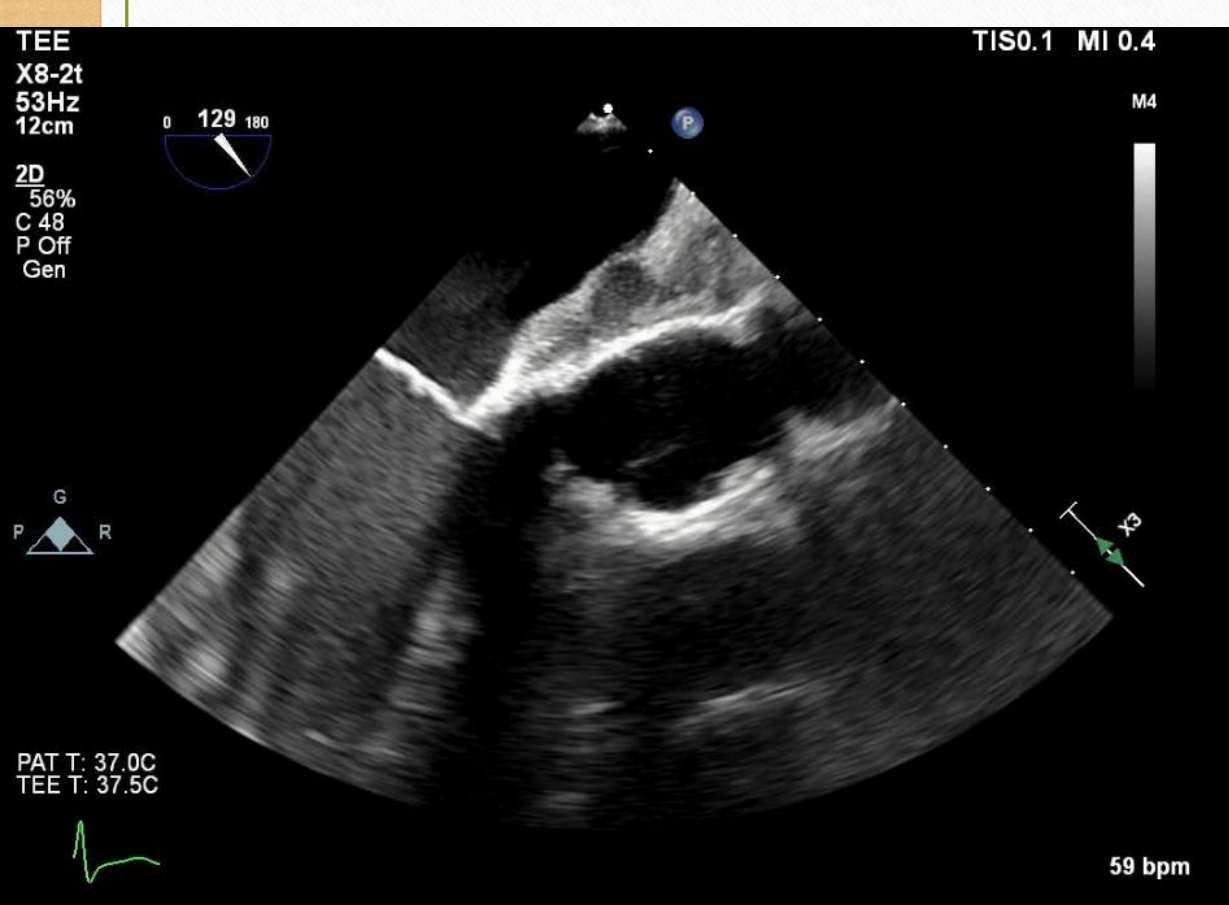
4D Cardiac CT Reconstruction



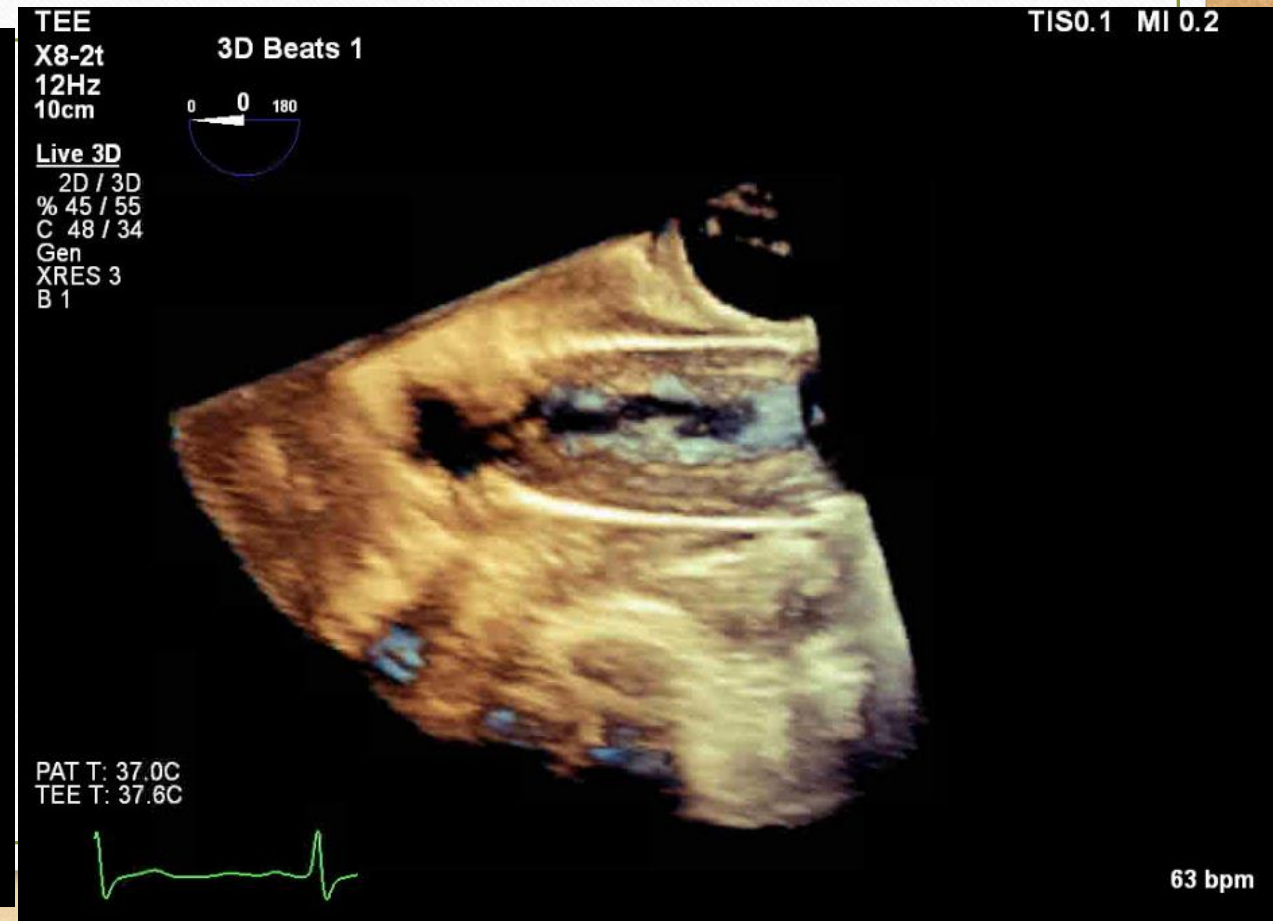
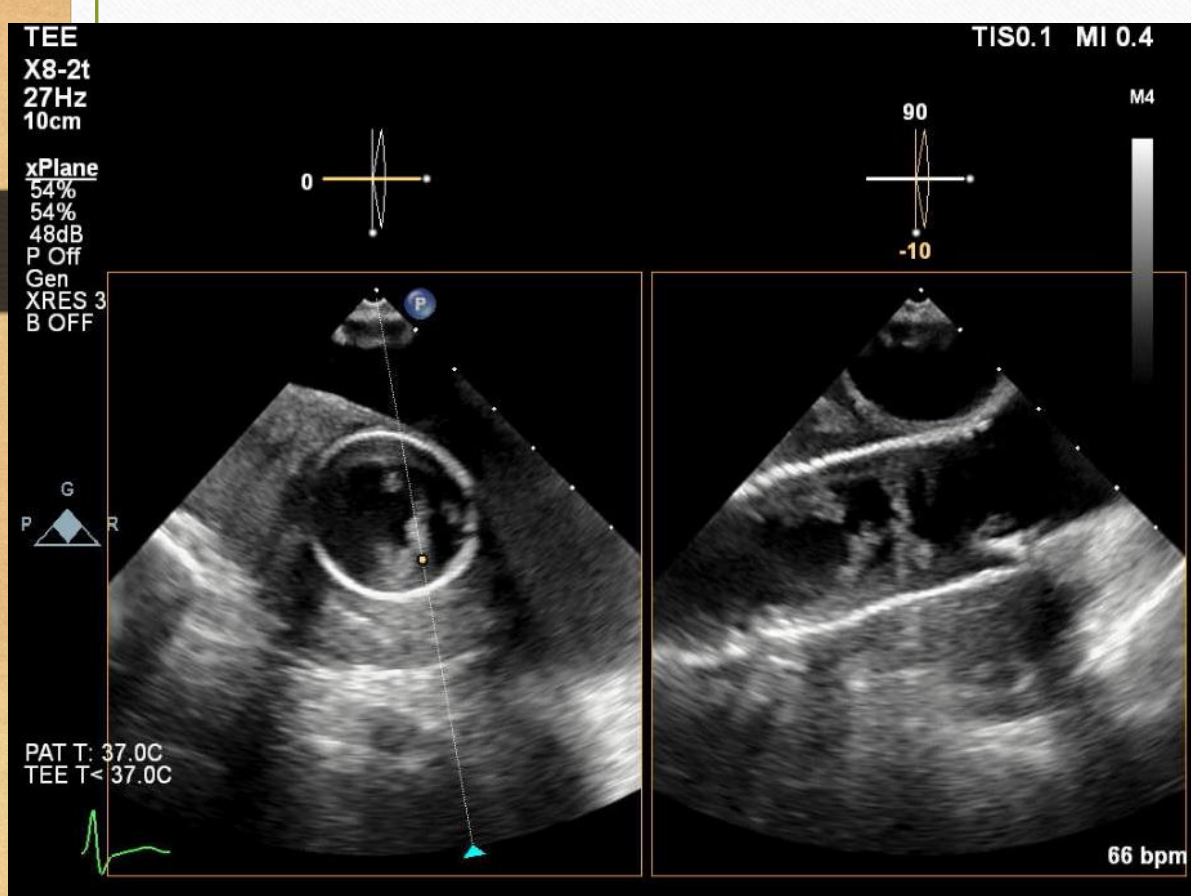
4D Cardiac CT Reconstruction



Peri-valvular extension on TEE



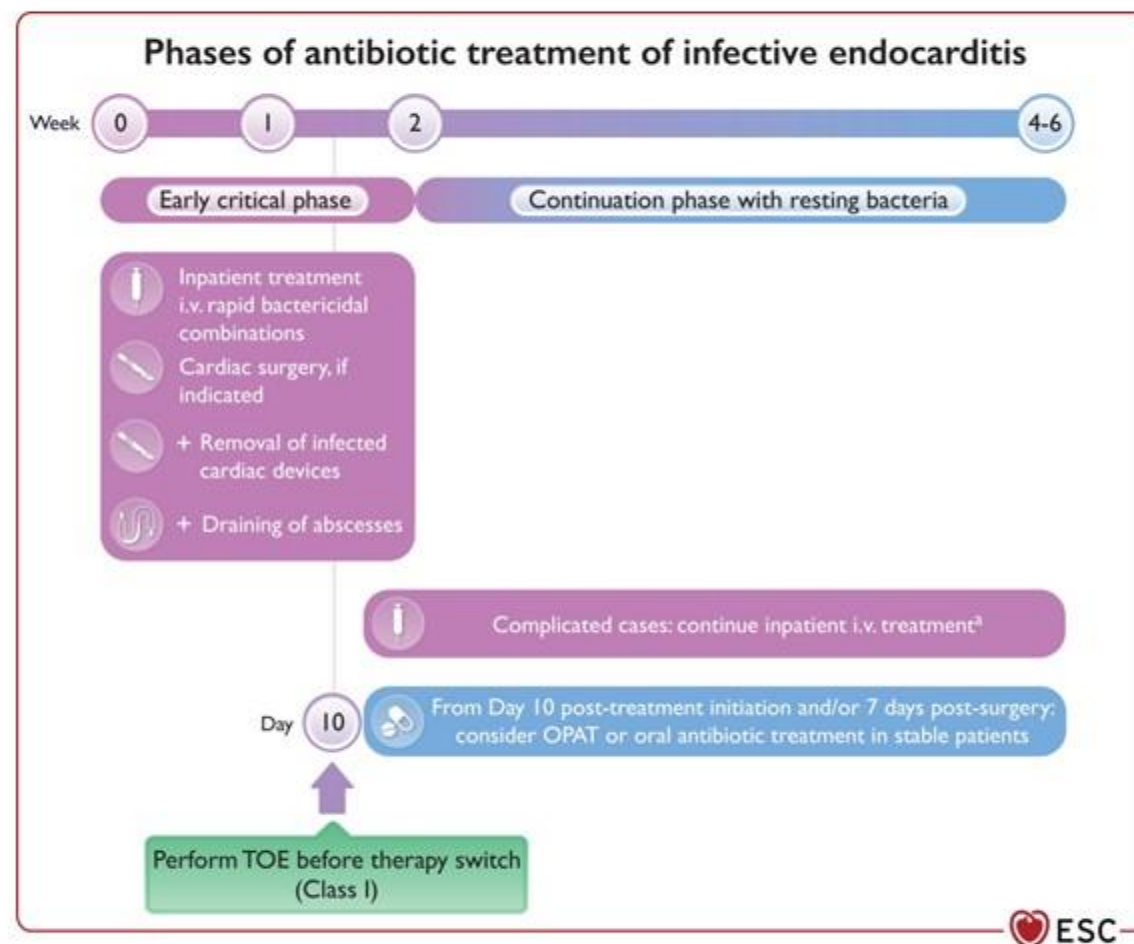
Don't Forget Aortic Grafts, too



Medical Treatment

- Bacterial Endocarditis
 - Antibiotics for 6 weeks recommended → pathogen specific
 - Look out for surgical indications
- Device related endocarditis
 - Remove/Replace Device + antibiotics

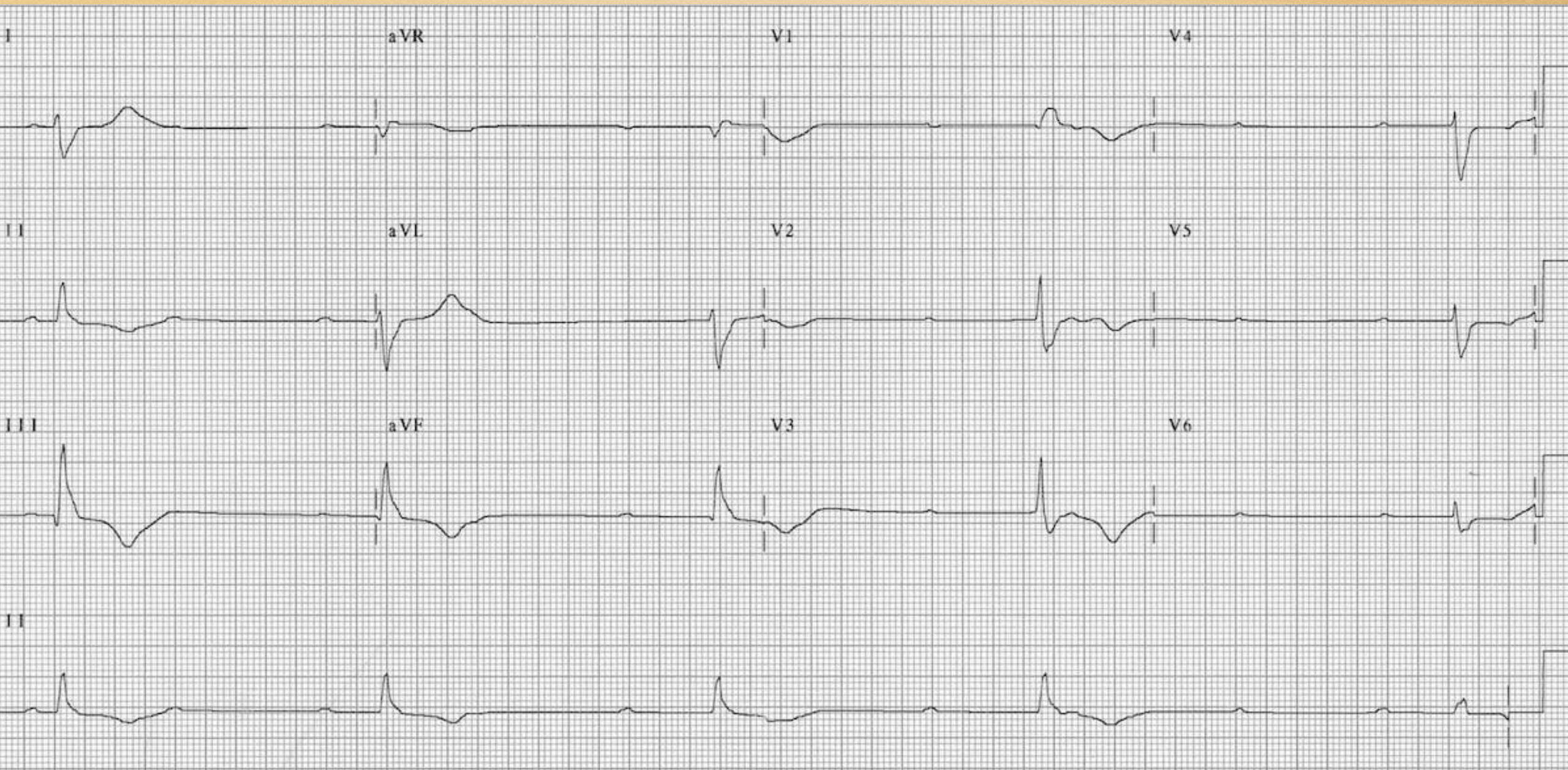
Figure 8 Phases of antibiotic treatment for infective endocarditis in relation to outpatient parenteral antibiotic ...



Take Home Point # 4

In anyone with prosthetic valve or intra-cardiac device and any infectious symptoms...always think about endocarditis

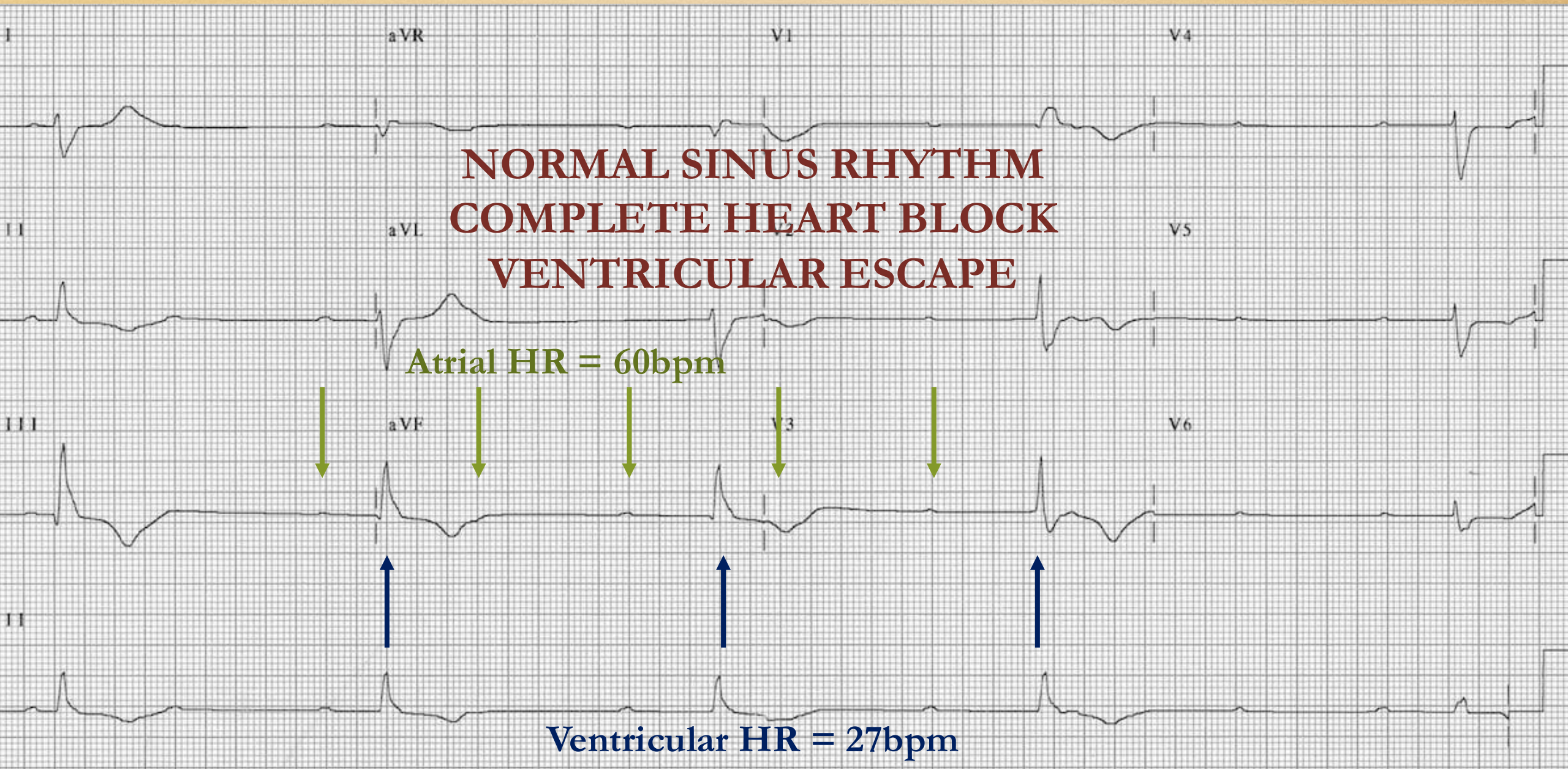
EKG in a patient with Endocarditis



**NORMAL SINUS RHYTHM
COMPLETE HEART BLOCK
VENTRICULAR ESCAPE**

Atrial HR = 60bpm

Ventricular HR = 27bpm



Surgical Indications for Bacterial Endocarditis

- New-onset CHF with associated severe, new-onset left sided valvular disease
- Highly resistant organism/persistent bacteremia or valvular abscess/fistula or penetrating lesions
- Large vegetation ($> 1\text{-}2\text{cm}$ in diameter) or clear embolic phenomena
- Prosthetic valve endocarditis
- Heart block/Rhythm disturbance

Take Home Point # 5

Surgical indications in IE include stroke, large vegetation, heart block and severe CHF

Question # 1

- What is the most common risk factor for infective endocarditis in Africa?
 - Rheumatic Heart Disease
 - Bicuspid Aortic Valve
 - Intravenous Drug Use
 - Congenital heart defects

Question # 2

- Which of the following is an indication for surgery in patients with infective endocarditis?
 - ECG with Wenkebach (Mobitz type I AV block)
 - 0.8 cm calcified vegetation on the mitral valve
 - Vertebral artery stroke
 - Presence of roth spots and Janeway lesions on exam

Conclusion

- Morbidity and mortality associated with IE in Africa remains high
- Challenging diagnosis; use Duke Criteria and predisposing conditions
- TTE and likely TEE for all patients under suspicion or with prostheses
- Knowing surgical indications is essential

Questions?
